

Don't Waste Your Breath

An Introduction to the Mysterious World of the Adolescent Brain

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Abstract

Adolescents are a mystery to many adults- especially their parents, It is a time when three of the great changes of human life occur: the ability to reproduce: the establishment of an identity and the formal commencement of logical rational reasoned thought. Though the attainment of logical thinking is fairly patchy from where I sit. This presentation provides a wry and possibly even helpful overview of the way adolescents think. Based on a synthesis of recent research on early adolescence and mind development, implications for schools and families will be discussed.

Adolescents are a mystery to many adults- especially their parents, It is a time when three of the great changes of human life occur:

- the ability to reproduce;
- the establishment of an identity ; and
- the formal commencement of logical rational reasoned thought.

Though the attainment of logical thinking is fairly patchy from where I sit and some people don't seem to attain it till the age of 58 or thereabouts.

There is a long history of successful people having fairly dodgy adolescent years and this has been reflected in their school reports. For example,

Stephen Fry, the English comedian's, headmaster wrote on his report in the early seventies,

" He has glaring faults and they have certainly glared at us this term".

Carl Jung was similarly dismissed by his teacher who commented,

'all glib cleverness and humbug".

So let's take a walk through the brain and mind of your average adolescent. Now this is dangerous territory indeed. It's not just the likelihood of tripping over the odd torrid sexual fantasy, encountering an obsession with privacy that would baffle the most secretive hermit or the risk of being crushed by the wild pendulum of mood swings.

No, even more dangerous than that is the knowledge that this is an area of research that is expanding so rapidly that in a few short years much of what I am about to say may well seem laughable in its simplicity.

Oh, well fools step where angels fear to tread and as I'm certainly no angel here goes...

Development

We have probably learned more in the past few years about the way people learn than we have in the past fifty years. For a full discussion of this area see Gopnik, Meltzoff and Kuhl, 1999; Restak, 2001; Damasio, 1995). Much of this upsurge has been due to the proliferation of PET scans (Positron Emission Tomography) and fMRI (functional magnetic resonance imaging) studies,

The three pound blob of grey matter that sits on the top of your neck is the most complex, adaptable, regenerating object we know of. And it's busiest when we are children.

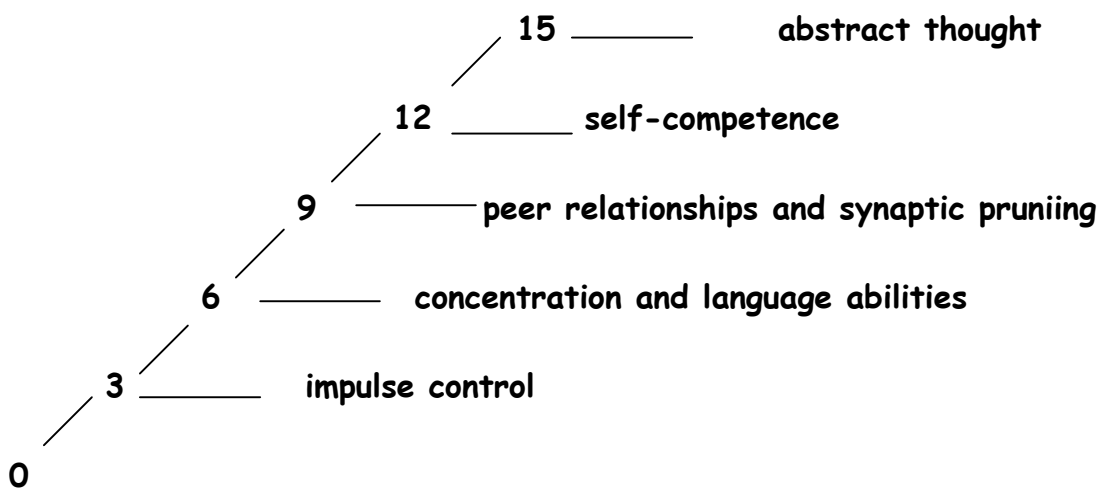
The way the mind develops is not a neat sequence of events. Recent research is confirming what two of the great thinkers of child development (Jean Piaget and Maria Montessori) postulated that children's minds develop in fits and starts followed by periods of consolidation. These processes were labelled as assimilation and accommodation by Piaget and were described as cycles of learning by Montessori.

In terms of brain development, there appear to be times of overproduction or exuberance during which we may be highly receptive to new information and able to gain specific skills more easily. During childhood and adolescence, this seems to be the way the brain develops- overdoing it in terms of production and then cutting back on what is not needed later. It's a pretty

nifty system because it's precisely that over-production that allows us to choose to hone and specialise our skills.

If we place a map of key social competencies at different ages, we get a map of approximately three-year cycles. Of course there is individual variability as well as gender differences but nevertheless a map such as the one presented on the next page can be used to help schools target specific behaviours and learning processes at different times.

A Map of the Development of Mind



Children's brains are much busier and quite a bit cleverer than adults are. From birth, the brain is busy setting up connections. At birth each neuron has 2,500 synapses and the number increases rapidly so that by 2 to 3 years of age, there are 15,000 synapses per neuron. Preschool children have brains that are more active, more connected and more flexible than ours. In many ways you could argue that you will never be cleverer, more flexible or more adaptable than you were when you were three.

Up until the age of three, children are like sponges. Given sufficient time and attachment with a caring adult and a reasonably interesting environment and they just learn. They absorb their surroundings and are especially interested in differences. In fact they learn by being attuned to differences. This is true of babies and remains true for all of us throughout our lives. Babies are particularly interested in faces and stripes.

This means from birth we are intensely interested in our social environment, we notice difference, we focus our learning towards emotions, we try to draw causal connections between events and we want to create meaning and to try out our knowledge in new settings.

We are born to learn about new places and people and to adjust to what we find there, This means children already know a whole lot more about learning than adults do.

Then about the age of three or four years of age, something happens and it all stops, It is almost as if four year olds stop in their tracks, look around in bewilderment and express this puzzlement by asking the question "why?" It is estimated that a four year old asks a "why" questions every two and a half minutes!

These are the wilful years in which children learn impulse control. Children who do not learn this at this time can learn how to control their impulses later but it is harder. Some of you will know adults who never really learned much about impulse control either. You know those so-called friends of yours who cut a swathe through any social settings, acting in ways that disregard the needs of others, failing to take on responsibility. Adults who in short suffer from the " who poo-ed in my pants" syndrome.

Around the age of six, there is a second surge as the brain starts to use language in increasingly complex ways. Aggression management is an important social competency at this time. Entering school, every year are children with existing attachment and aggression problems and they don't just grow out of it, They get worse! Much, much worse. Girls exhibiting these problems at this age do worse long term than boys..

Up to the age of nine or ten the brain continues to be twice as active as an adult's. Around the age of nine years peer relationships seem to predominate.

Primary schools often find that bullying increases around this age as children jostle for position with peers. For this reason, it makes sense for schools to centre peer relationship programs that include bullying prevention, emotional intelligence and resilience.

It's at this point that we start to see the brain gearing up for adolescence. Many of the neurological changes that occur in the brain during the teenage years commence well before they get to high school. A fact any primary school teacher will confirm with a sad nod of the head.

While the earlier onset of puberty is often viewed with dismay by adults, it may actually benefit some young people. Early maturers score slightly higher on IQ tests than their later maturing counterparts and this small advantage appears to persist into adulthood (Newcombe and Dubas, 1989)

During these years, the brain starts to slow down. An 8 or 9 year olds brain runs at about twice the speed that yours does and between 8 and 18 it slows down to its adult running rate. As some of you will know it takes all of Year nine off for a complete break. I always am amused to think that in most organisations after ten years service, you get a break called long service leave. Year nine students have been in the system for about ten years and could do with long service leave.

Interestingly, this appears to be followed by a split pathway with some students languishing and loitering their way in to the senior years. While others, often around the middle of Year Ten, the shutters come off, they come out of the fogs and mists of adolescence, the light goes back on and they suddenly get it in a way they haven't for years. The lucky parents of this group heave a sigh of relief and if they are clever, take credit for it all.

Synaptic Pruning

Between ten years of age and puberty, the brain ruthlessly destroys its weakest connections preserving only those that experience has shown to be useful, The adage here is "use it or lose it" - and this applies at any age. "Synaptic pruning" continues throughout life but occurs mostly during the late childhood and teenage years so that the synapses that carry the most messages get stronger and the weaker ones get cut out, This helps in refinement and specialisation.

This is why the experiences we give children and young people between their 9th and 18th years are so important.

As many as 30,000 synapses may be lost per second over the entire cortex in the early adolescent brain leading to an ultimate loss of almost one half of the synapses that were present in the pre-adolescent period.

Jerome Bruner has suggested that humans are dependent for so long is so they can learn about their specific social environment. We survive by learning how to get on in almost any setting, by living by our wits and by being extraordinarily adaptable.

Re-structuring and the frontal lobes

The second thing that happens in adolescent's brains is that the frontal lobes - the bit that helps us to plan, consider, control impulses, make wise judgements in short to be kind, caring, considerate people- is the last bit to mature. In fact someone probably should put a sign of the frontal lobes of most early adolescents saying "closed for construction" The frontal lobes are being re-structured at this time in a way that prepares them for adult life.

If you are wondering what's the big deal with the frontal lobes. It's really the frontal lobes that allow us to be civilised and human. Susan Greenfield estimates that over the course of history the size of frontal lobes in humans has increased by 29 percent compared with chimpanzees who have increased by 17 % and cats whose frontal lobes have only grown by 3%.

This not only tells you a lot about why a hungry cat won't leave well enough alone, it should give you pause to think compassionately about your ancestors who had to spend their lives hanging around with a group of eternally impulsive and erratic teenagers of various ages while working out a way to produce evolutions latest upgrade- you! I hope you are dutifully grateful.

So if the early adolescents frontal lobes have essentially gone missing in action for a time. This means that teenagers' brains are all tuned up for emotions, fighting, running away and romance but not so well tuned up for planning, controlling impulses and forward thinking.

This means that when a frustrated parent says to their " why didn't you think of the consequences" , the kid invariably replies "as if". By the way you know that " whatever" means yes and "as if" means no, don't you?

Some parents kind of forget this. They wouldn't dream of giving their teenager free access to their life savings but they will reasonably frequently leave them in charge of a \$ 200,000 house full of fine furniture and still be stunned by the results!

Parents need to be their teenage children's frontal lobes. Asking an adolescent to do a lot of forward planning is like asking a dog to study physics.

This is also the reason why too much freedom too soon does not seem to help too many young people.

Early teenagers are yet to grown into themselves yet. The average teenager gains 20 kilograms and grows almost half a metre in the space of four or five years. I'm sure many of you know the sensation of being in a room with a group of young people who seem to be a clumsy jumble of elbows, knees, pimples and groins. Just as they haven't grown into their bodies. They haven't quite grown into their brains either.

It's almost as if teenagers at this stage have a very powerful, juiced up sports car with great acceleration, terrific lines, great sex appeal but very poor brakes... oh, and a driver with the road sense of an earwig.

Emotions

A couple of other interesting things are happening in the adolescent brain. The first is that hormones become more powerful and adolescent's brains show more activity in the emotional parts of the brain (known as the limbic system) than they do in the planning and impulse control parts of the brain (known as the frontal lobes and the pre-frontal cortex).

This means that adolescents learn best when there is emotion involved! Adolescents remember stuff about themselves and stuff that is relevant to their life situations. As Homer Simpson would say " doh!"

We might do better if we were to synthesise all subject areas into an intensive study of soap operas at this point.

In a large and intricate study Assor, Kaplan and Roth (2002) found that fostering relevance to students authentic goals is more important than providing choice. The big implication here is if you want them to be interested in school - make it relevant!

It's almost as if the brain is acquiring a new set of survival skills at this point. It is worth, I think, returning to a point I made at the start of this talk that adolescence is a time when three of the great changes of human life occur:

- the ability to reproduce;
- the establishment of an identity ; and
- the formal commencement of logical rational reasoned thought.

Of these we could argue that the establishment of an identity that is acceptable and desirable to peers would have great survival value for humans.

The puzzling thing to me is that if the brain at this time is so tuned into the emotions, why don't we capitalise on this? Instead it seems that we are yet to grasp in any meaningful way that there is a great deal of crucial learning that simply cannot be accomplished while dressed up in uniforms that promote sedentary learning or timetabled in the itty-bitty episodes we call lessons.

Is the teaching of 'subjects' that obliges each secondary teacher to try to cope with success in learning for 150 to 240 individual students really the best model we can come up with? Most primary teachers, by comparison, develop meaningful and trusting relationships and expectations that are both realistic and rigorous for those in their care.

It may well be that the brain develops best when allowed to play, linger and persist in areas of interest and that this may especially be so, when the early adolescent is in the company of someone whose opinion he or she cares about.

Myelination

Another thing that is happening in adolescents' brains is myelination. Myelin is a fatty material that wraps itself around the axons of brain cells, Myelin helps the brain to communicate quickly and efficiently. Simply put, it turbo charges thinking. Myelin increases by about 100 % during the teenage years

In multiple sclerosis, it is the myelin sheath that breaks down causing such devastating effects for sufferers.

It is during the adolescent years that myelin is put into place. Two areas of the brain that are extensively undergoing myelination are the hippocampi, which has to do with memory; and the cingulate which involves emotions.

This research explains two of the great mysteries of life with teenagers. For years I would watch parents say to their adolescent children " what are you thinking about?" only to receive a blank look, a shrug of the shoulders and a "dunno". For years I thought they were putting it on. Now I really think they don't know. They weren't thinking at all. That blank look was completely justified. They were only reacting.

The research indicating the level of myelination of the cingulate also points to solving the mystery of some family interactions. As Damasio has pointed out the cingulate is involved in moral reasoning. The relative inability of early adolescents to think through consequences and measure their responses again partly explains another common family interaction. For years, in family therapy parents have lamented how their teenagers went absolutely berserk, over the top, ballistic, apeshit and so on when asked to do something minor like take out the rubbish bin.

The great mistake that parents (and some teachers) often make here is to think that more words, more explanation will help smooth things over. Well, I'm here to tell you folks, you might as well be talking about billiards to a baboon for all the success you can expect to have.

This supports Bill Roger's suggestions for teachers not to get involved in secondary issues.

This all means that adolescents sometimes need more help with planning and organising themselves than you would believe.

Obviously it is important to help young people to become as self-reliant as possible. In some instances, however, parents can help with organisational details.

Increased affiliation with Peers

It's not going to come as news to anyone here that the adolescent brain is not only tumultuously emotional, it is also incredibly social.

As Linda Spear points out, most species show an alteration in social behaviour around the time of adolescence. Play fighting and play behaviour increase before declining as sexual maturity is reached,

During an average week, adolescents have been reported to spend close to one third of their time awake talking with peers but only 8% talking with adults (Csikszentimihalyi, Larson and Prescott, 1977).

The intensity of peer relationships may serve two purposes here: an evolutionary advantage and a learning one.

The interest in peers may have traditionally helped the dispersal of adolescents away from the family group thereby avoiding inbreeding. An age related emigration is common among mammalian species and may be evolutionarily adaptive.

Peer affiliation may also promote learning. In terms of learning, humans are hard-wired to do two things:
experience differences;
and to imitate.

These imitations are tried out and if successful become patterns or habits.

Teenagers are nothing if they are not great imitators. Fashion, music, lip gloss, lynx deodorant- it's all around you!

As well as being great imitators, they are wary in case they lose peer approval. So they are to quote Con the Fruiterer, "looking, looking, looking!"

Improving Concentration

Did anyone ever say to you, "you've got a mind like a sieve?" Well, they were right!

Approximately 99% of the information that comes into your awareness is immediately discarded. That's just as well because if it wasn't you would be swamped with trivial detail. Thankfully, you are a very discerning person. When you were an adolescent however you weren't quite so discerning.

All children, not just those with attention problems, need to develop their concentration.

The amount of learning we can do directly relates to our ability to concentrate and focus our attention, Einstein, Newton and Darwin were all noted for their ability to concentrate,

Concentration is our ability to draw our energy towards a specific issue, which we can then attend to. There are two types of attention: one is diffuse and allows us to absorb information in an uncritical way without judging it; the other is narrower and focuses on specific details. Both types of attention are necessary. For example, when crossing a road it is vital to keep your attention of where the car approaching you is if you are to avoid being hit. However, it is also important to keep some attention for noticing

diffuse events such as another car coming around a corner, or a truck overtaking and so on.

Find your concentration wandering just then? Well, its just your mind searching around for something new and interesting to focus on.

Concentration is a bit like a bouncer at a nightclub. It rapidly inspects candidates (in this case ideas) for admission to the brain and filters out and discards those that it thinks are not worthy. Some kids have a bouncer that lets in too many ideas, others the wrong sort. So the trick to effective concentration is to learn what to concentrate on and what to filter out. Most of us are skilled at screening out irrelevant information. For example, most of you will not have been aware of your shoes on your feet until your attention is drawn to it. Young people are often less skilled at working out what is the main thing to concentrate on.

Like any other skill, concentration can be enhanced and made more automatic. Anyone who has learned a complex set of manoeuvres such as riding a bike, playing a musical instrument or driving a car will have experienced the initial concern of " how do I concentrate on all these things at once" only to find with practice they become easier.

Extensive practice allows for the development of pathways of concentration. You might like to think of the activities that give your child a sense of flow here. Some aspects of a performance can be so well rehearsed that they can be perceived as happening automatically. Some musicians speak of " finger memory" where they no longer need to consciously think about what they are playing and attention can be freed up for other activities.

Motivation

Adolescents are harder to motivate and are motivated by different things that adults. They seek out new stimuli, novelty seeking and risk taking.

Synaptic pruning may be associated with a major decline in the amount of excitatory stimulation reaching the cortex. Glucose metabolism, a measure of brain activity, declines during the adolescent years.

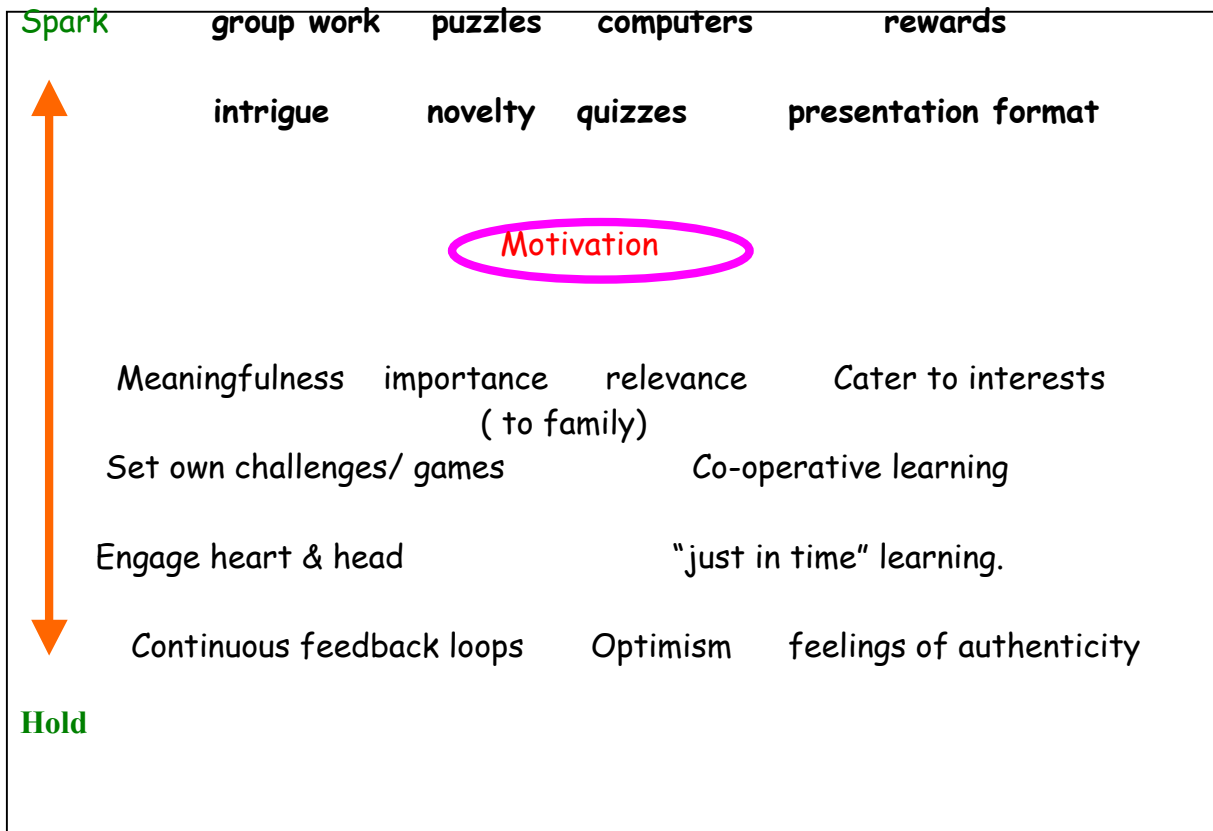
Between late childhood and early adolescence there is a "fall from grace " with the number of reports of feeling " very happy " dropping by 50% (Larson and Richards, 1994). Even when engaged in the same activities , adolescents find them less pleasurable than adults. They experience an increase in negative feelings, depressed mood and mood ranges that younger or older people

Therefore they may attain less positive impact from stimuli with low or moderate incentive value. Part of the answer is to bombard with positive experiences.

As children get older their attitude to school deteriorates and adolescents' academic motivation declines over time.(Hidi and Harackiewicz ,2000). Considering how to increase motivation in students is a major issue for schools.

One way to do this is to build upon the interests of students and link as many educational outcomes to these as possible. Interests are reasonably stable over time. However, what sparks people's interest and what holds their interest are two different things.

The table on the next page summarises these strategies for sparking and holding interest.



You may have noticed "rewards" mentioned on the table above. This is point of some controversy. It is often argued that extrinsic rewards undermine intrinsic motivation (Deci, Koestner and Ryan, 1999). This may be so, though it seems the view of intrinsic versus extrinsic motivation is too simplistic. Rewards do not reduce intrinsic motivation for dull tasks and may be useful in sparking interest. Rewards might be especially useful for academically unmotivated students.

High novelty seeking in pre-teens predictive of conduct problems, alcohol use
 The need to seek novelty shows itself in three main areas during adolescence:

- risk taking
- anger and aggression
- drug experimentation

Sleep

Adolescents eat more and they sleep less, They have a preference for sleeping and waking later than they did when they were children.

Adolescents need more sleep than they did as children around 9 and a quarter hours and that their circadian rhythms appear to be set later than children's or adults, Melatonin flows into their brains later around 10.30 pm and stays longer. Most teenagers' brains aren't ready to wake up until 8 or 9 in the morning,

Teenagers who are sleep deprived do less well at school and are more prone to feelings of sadness and hopelessness. In short, they feel fairly crappy.

As suggested by Pat Wolfe some guidelines are:

Stay away from caffeine and nicotine after noon. Avoid alcohol that can disrupt sleep.

Don't sleep with a computer or TV flickering in the room,

Avoid bright light in the evening but open blinds or turn on lights as soon as the morning alarm sounds to start the body's awakening cycle,

Sleeping more than two or three hours later on weekends than on weekdays can disrupt your body clock.

The sleep cycle influences our "down times", the times we learn least well of all. Your down time is fairly easily calculated. Take the mid point of your sleep cycle go forward 12 hours and thereabouts will be your down time. (Restak, 2002)

Stress-sensitivity

The decision making ability of adolescents may be more vulnerable to disruptions but the stresses and strains of everyday living than that of adults.

They may also respond more strongly to stressful events physiologically with greater blood pressure and cardiac output response than children (Allen and Matthews, 1997).

Adolescents are often sleep deprived which may in turn increase vulnerability to stress,

Adolescents may have more negative life experiences (friendship changes, alterations in romantic liaisons, school work) that they tend to view more negatively and have less control over. This may well increase their sense of helplessness.

The more negative life events an adolescent has the more likely they are to engage in problem behaviours and the less likely that are to engage in a wide range of positive activities. (Simmons, Burgeson and Reef, 1988)

Adolescents display considerably poorer cognitive performance under time-limited situations than under optimal test conditions (Keating, 1990). This means that project based assessment may be the best way of assessing early adolescents.

Increased risk taking

Adolescents are risk takers. Reckless behaviour, sensation seeking, risk taking . Maggs, Almieda and Galambos (1995) found that 80 % of 11 and a half to 15 year olds exhibited one or more problem behaviours in a month (disobeying parents, school misconduct, substance use , antisocial acts such as theft or fighting)

As Tracy Moffitt has pointed out risk taking during adolescence is normative. Risk takers feel more accepted by peers and view risk taking as fun. Non-risk takers are seen as anxious and over controlled

Adolescents take risks for a variety of reasons:

*Sensations of novelty- this desire for an adrenaline rush may be particularly strong in those with few chances for other reinforcers. As Alfred Adler once commented, " people don't learn to try to succeed in socially undesirable ways until they have learned that they cannot succeed in socially desirable ways"

*Change or intensity of experience

*Improve chances for sex

- reduce dysphoria or cope with stress.

Risk taking can be seen as an attempt to gain real life experiences of your self and your environment

The perceived risks of risk decline during adolescence.

Anger and Aggression

Aggressive behaviour peaks during adolescence in a number of primate species. Aggression has its origins in the limbic areas and particularly the amygdala which relates to the emotions, and shapes "fight or flight" responses.

When emotional, adolescents have lower activity in their frontal lobes and more activity in the amygdala than adults. The amygdala may also be more easily activated in adolescents. In one experiment, young people were reported to exhibit greater activity in the amygdala than in the frontal lobes when engaged in a task requiring subjects to identify emotional states from facial expressions - adults showed greater frontal activity (Yurgelen-Todd, 1998)

One interesting but curious research finding is that it is young people with low resting heart rates that are more likely to be aggressive and engage in high risk behaviours. This raises the possibility that adolescents who have been exposed to high stress during childhood may habituate to that level of stress and become harder to excite or motivate and use more extreme ways of behaving and relating to others to relieve boredom.

Risk taking and Drug Experimentation

One way of relieving boredom is substance abuse. Some exploratory drug use is normative during adolescence. They may become dependent more rapidly than adults. Within a year of starting, smoking most attempt to quit but 97% are smoking two years later,

The young people with low resting heart rates that I mentioned above have an increased their susceptibility to substance abuse. For example, after peer substance use, perceived levels of stress most strongly predicts adolescent alcohol and drug use (Wagner, 1993)

Alcohol and cigarettes are often considered gateway drugs that can lead to more illicit drug abuse, Early onset alcohol use powerfully predicts later alcohol abuse and dependence. May alter neural development, Other risk factors collect around early initiation into alcohol use.

Summary and Key Implications of this Research for Schools

So what does all this mean for schools? A number of things:

1. Realise that adolescents are not just a smaller version of adults, The adolescent brain is in transition. It differs neuro-chemically and anatomically from adults.
2. Remember that adolescents frontal lobes are "closed for construction". Expecting teenagers to show a lot of fore thought, planning, consideration and impulse control is like expecting a goldfish to recite Shakespeare.
3. Grab them by their emotions. If you want adolescents to learn make it emotionally relevant to them. Use their TV shows - Friends, Home and Away, Dorks on Heat - to spark their interest. The major interest and activity in the adolescent brain is all about the "two F"s"- do I fight it or do I .. er.. become extremely friendly with it.
4. Bombard them with positives. This is the age where motivation gets tricky. Use rewards, damn it use anything you can think of to keep them intrigued with learning. If at the end of these years, they can say I like learning, it's fun and I can do it, you deserve a medal
5. Last but not least, never underestimate your power. Adolescents need someone around them - an adult who has more options than they do. Someone who they may battle with, but someone who ultimately they imitate and emulate and believe it or not, that someone is you. And the best way of maintaining at least the illusion of having more options than they have, is to know when not to waste your breath!

Andrew Fuller

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